gravitational constant: $G = 6.67 \times 10^{-11} \frac{Nm^2}{kg^2}$ **Name**_____

Date_____ **Pd**____

Central Net Force Model Worksheet 4:

Orbital Motion

1. Suppose you are at mission control on the moon, in charge of launching a moon-orbiting communications satellite.
   Moon mass = 7.36×10^{22} kg Moon radius = 1.74×10^{6} m

   a. First, how much would a 1500 kg satellite weigh near the surface of the moon? (The gravitational field strength on Earth's moon is 1.6 N/kg.)

   b. The satellite is to have an altitude of 100 km above the moon's surface. What is the radius of the orbit of the satellite?

   c. When the satellite is in orbit, how big will the centripetal force be? Explain.

   d. Find the required orbital velocity for the satellite.

   e. How long will it take the satellite to orbit the moon? (This time is called the orbital period.)

   f. Is this satellite accelerating while in orbit? If so, what is the direction and magnitude of the acceleration?

2. a. Why do astronauts float aboard the international space station? What sensation does an astronaut feel while in orbit?

   b. Are astronauts in orbit really "weightless"? What might be a better description?

3. The space shuttle aims for an orbit about 250 km above the surface of the earth. In orbit, the mass of the space shuttle is about 95,000 kg.

   Earth mass = 5.98×10^{24} kg Earth radius = 6.38×10^{3} km .

   a. Calculate the orbital speed of the space shuttle.

   b. Calculate the orbital period of the space shuttle.

Earth mass = 5.98×10^{24} kg Earth radius = 6.38×10^{3} km

4. Back in Galileo's day, one of the objections to the heliocentric model of the solar system is that if the earth is spinning, we should all be "thrown off the earth." Actually, you do weigh a bit less on the equator than you would at the poles. Calculate how much. (Hint: Construct force diagrams for a 100 kg person standing on a bathroom scale at the equator and at the pole, and do the F_{net} calculations.

5. The earth's orbit around the sun is very nearly circular, with an average radius of 1.5×10^{8} km.

   a. Determine the average speed of the earth in its orbit around the sun.

   b. What is the magnitude of the earth's average acceleration in its orbit around the sun?

   c. Determine the gravitational force on the earth by the sun. How does the force on the earth by the sun compare to the force on the sun by the earth? Explain.